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THE DUST OF THE GOBI

Jacques W. Redway, F.R.G.S.

In times not greatly remote, as geological times are measured, the Yellow Sea of the Asian coast curved into the northeastern part of China to a distance of about three hundred miles from the present shore line. A hundred miles or more from the old coast the Shantung highland formed a fairly rugged island about as large as Pennsylvania and New Jersey. The inland sea surrounding it was comparable in size and shape to the Gulf of Mexico. The old shore line is comparable to the Fall Line of the American coast plain. As centers of activity have grown at the Fall Line, so also for similar reasons, cities have grown in China where the alluvial plains, once the head of the Yellow Sea, join the piedmont lands which then were the coast region. From Yung-ping in the north, around the semicircle to Ning-po in the south, a chain of great centers of population, each one a " fu," or city of the first rank, marks the old shore line.

The great plain of China, one of the most productive regions on the face of the earth, is not much larger than the semicircle of the Gulf states. Yet it supports two hundred million human beings—about twice the population of the United States. Except for bosses of rock, remnants of the original surface, that protrude above the sea of alluvium, the plain is so flat that the earth's curvature may be determined therefrom.

Two forces of nature are chiefly apparent in shaping the earth's surface. Diastrophism crumples the rock envelope into wrinkles, folds, and faults; wind and water are almost equally active in wearing off the high spots and filling the low ones. It is so in Mongolia and China. The Great Wall is a physical boundary between Mongolia and China; but the slight balance of rainfall which makes China productive and most of Mongolia a desert is the real, though invisible boundary. And this boundary, rain, has been the chief instrument in the building of China's plain, and likewise in the destructive work of the Hoang River, China's great sorrow.

Fierce desert winds, black with their loads of rock-waste, have filled the old valleys and canyons of desert Mongolia with coarse detritus worn from mountain crests and scarps. That is their legitimate business. Desert winds usually are of the gale type. The onset of a simoon is a dense black cloud of dust—coarse, medium, and fine. The heavier dust cannot be carried high above ground, and does not go far beyond the desert, since the wind slackens materially at the desert boundary. The lighter dust, being carried high into the air—higher than the passes, even than the block ranges—reaches the great plain, and in some dust storms even reaches the coast. The air is thick and glistening with yellow dust; and sometimes as much as one tenth of an inch settles on the ground after a severe dust storm. The fact to be borne in mind is the constant transference of dust over all northern China by prevailing winds—desert winds occasionally, prevailing westerlies practically all the time.

The distribution of the dust mantle is not effected wholly by the winds. The erosion that attends rains, and the natural tendencies of gravitation, move the dust toward the various river channels. The rivers themselves, especially the Hoang, have been agents of tremendous importance. The Yangtze, because of its swifter current, and of not receiving so great a volume of dust as the Hoang, is able to carry all that is dumped into it and has never been a great source of trouble. The Hoang and its chief tributary, the Wei, receive far more of a load than they can carry, and from time to time have broken their banks and have spread their sediments all over the great plain. Perhaps uplift has raised the old head of the Yellow Sea above sea level, but the sediments spread by the floods of the Hoang now cover the plain very deep, in places exceeding one thousand feet. Gentle winds tend to spread the dust mantle evenly, while the forces mentioned above tend to clear it from the high spots and carry it to the low. The greater depths of loess, therefore, are in the river valleys.

Where the current of the river is swift enough to cut into the loess, the water has carved into the deposit, lowering its channel and leaving vertical banks of ten, twenty, and thirty feet or more in height. Among the Chinese, the economy habit is always prominent. Dwellings built on the floodplain would cover ground that might produce foodstuffs. So the patient farmer tunnels and burrows and excavates into the bank of loess, making not only dwellings, but village communities in the banks. The troglodyte population of the flood plain is very large.

The character and composition of the loess accounts for the density of the population of the great plain. Physically the loess is the lightest of the wind-blown dust; therefore it is the most easily moved, and likewise it is carried farthest by the winds and the water. In cultivation, a man's strength is sufficient to drag the primitive plough through it and to turn the furrow to the necessary depth. Here, human strength performs the labor for which animal or mechanical force is necessary elsewhere. In spite of intensive cultivation, the ground is in a condition of almost perpetual fallow.

In composition, the loess consists mainly of ferruginous clay, fine sand, potash, lime, and nitrogenous matter. The last is derived from the grass and reeds which, while growing, are covered up by successive additions of wind-blown dust. What better material for soil can be found anywhere in the world? In many places three crops of grain are grown each year on loess soil. Perhaps the soil of the Nile delta and the lower Mississippi may be capable of supporting as dense a population as that of the great plain of China, but neither can suppass it in productivity.

Northwest winds are the beneficent winds of the northern hemisphere, and they are true to their reputation in China. The physiographic processes whereby the nutriment of the soil is carried from a desert region to one of moisture and productivity may be compared to the process of distillation which separates the useful from the refuse. Because of it, it is not much of an exaggeration to say that the most fertile region of the world is born of the most desolate of deserts.

The dust burden delivered to the Hoang is born of the desert region to the northwestward. The winds spread it over the upper watershed; wind, rain, and flood in concert spread it over the great plain. A stream that flows through aeolian or through sedimentary deposits is doing one or another of three things: the water is cutting away rock waste; it is carrying silt; or it is depositing sediment—all depending on the velocity of the current. The current which drops silt, cannot pick it up nor carry it; the stream must therefore flow over it or around it. Ordinarily, from Kai-feng-fu, the capital of Honan, the slope of the plain decreases slightly, and the velocity of the river therefore is checked. It is from this locality, therefore, that sedimentation chiefly begins. The deposit of sediment is greatest in winter, when the volume of water is lowest. With the advent of the spring rains there is a volume of water of flood proportions that is treacherous, tempestuous, and at times overwhelming.

The Hoang is the largest river of northern China. The Nile possibly excepted it has been more intimately connected with the economies of the world than any other river. According to the Shu-king, the Books of History edited by Confucius,[1] a most destructive flood followed the bursting of the levees of the river about 2200 B.C. The work of restoring the revetments and adjusting the channels to the volume of the water made the name of the engineer, Ta-yu, famous for all time. His engineering skill has not been surpassed or even equalled by his successors, and his method of river control may be heeded by the enginers of today. It is practically the method adopted by the engineers of the Mississippi River Commission—namely, the adjustment of the velocity of the current to the maximum load of silt which the water carries. The hydraulic engineer of today accomplishes this by impounding the excess of water during flood seasons and releasing it during seasons of drought; Ta-yu accomplished the same result by the construction of additional channels. In the lower part of the plain nine additional channels were constructed. Any number or all of them could be thrown open to a flood; any number of them might be closed as necessity demanded. Thereby, a uniform volume of water and a constant velocity of the current was insured.

It was a task of thirteen years. Thrice, according to the Shu-king, Ta-yu passed his own door without even staying to caress his child. His efforts succeeded; and in the land of his birth the name and the fame of Ta-yu will never pass to the unknown. Incidentally, his father before him had been the engineer in charge, and for failure to control a wild flood, had been permitted to become his own executioner.

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[1] The Latinized form of Kung-foo-tse.

Unfortunately, the wise plans of Ta-yu have not always been followed by his successors, who merely built embankments where high waters threatened overflow. Dikes and embankments were built of the sediments which the water dropped, and the engineers ignored the fact that the current which dropped them would quickly pick them up if the velocity of the current were slightly increased. As a matter of fact, the specific gravity of the sediments along the lower river is scarcely greater than that of the water itself. In contact with still water, loess soil soaks to a slime; against the impact of a swift current it seems to melt away. Reeds, grass, and shrubbery bind it wonderfully well, but vegetation of the sort in Honan is quickly gathered for fuel. Forest growths, the best insurance against quick floods, have long since been removed from almost every accessible part of China.

When a stream cannot carry the silt which it holds in suspension the silt drops to the bottom and sides of the stream bed, thereby building the bed and banks higher and higher. In 1844, Abbé Huc,[2] a distinguished missionary and geographer, noted that throughout the greater extent of Honan and Kiang-su provinces the river bed was materially higher than the plain—in places as much as twenty-five feet. A few miles west of Kai-feng-fu the Hoang makes a sharp bend, throwing the full force of the current against the dikes on the opposite side. He predicted as inevitable the terrible disaster which came in 1851, only seven years later. The dikes melted before a flood of tremendous proportions. A considerable volume of water remained in the old channel, but the bulk of the river poured northeastward. There was no channel to guide it, so the water spread out in a torrent fifteen miles wide. Not until it reached the Tsi did it gather into a channel, and even there the flood was beyond control.

When the river had finally adjusted itself the new channel lay to the northwest, and the main stream poured into the Pechili at a distance of more than three hundred miles from its former mouth at the Yangtze delta. Within the period of written history the Hoang has changed its channel nine times. A destructive flood occurred in 1887, and less serious floods have occurred within the past few years. According to the estimates of Europeans living in China at the time, the floods of 1851 destroyed more than one hundred cities and villages. The loss of life was at first estimated at two millions; subsequent estimates placed it at not less than seven millions. Within a period of one thousand years the Hoang has drowned more human beings than have been slain in all the wars of the same time.

Diking and channelling after the plans of Ta-yu might have been a great

[2] Souvenirs d'un Voyage dans Tartarie.

preventive of the disasters which have attended the floods of the Hoang, but a greater preventive must be found in the reforestation of the denuded slopes bordering the river valley. The railway engineers have already begun this work in a small way, but a measure of the sort requires national effort and control; moreover, nearly a century of time will be required to make it effective. "Confucius," says John Stuart Thomson, "held the cultivation of the mulberry tree to be a great virtue; and we, the outer barbarians, have been dressed in the finery from the product of the worms which fed on the leaves thereof. Had he enjoined the planting of the camphor and the fir in the west in the last three centuries, he would have saved the lives of ten millions of his race when the waters of the Hoang and the Han reared themselves forty feet above their banks."

The destruction of forests and protective vegetation has been China's great offence against nature, and nature has avenged herself by the destruction of the offenders. Perhaps the wise policy of Ta-yu, if followed in the future may result in controlling the floods, but reforestation is prevention, and prevention is better than cure.

In spite of the loss of lives by the million, and the destruction of property the value of which must be estimated by the billions of taels, the floods of the Hoang are not an unmixed evil. Every flood has covered the great plain with fresh soil that is full to the brim with nutrition—and nutrition is life. Birth rate is the measure of nutrition; and for every life that has paid the penalty of neglect, more than a life has been added. Life is in proportion to the richness of the soil. The coal and the iron ore deposits of China are the richest in the world, but the dust of the Gobi is richer.